Pam 599.742.4:591.13

UNIVERSITETET I BERGEN
ÅRBOK 1959
Naturvitenskapelig rekke
Nr. 5

The Norwegian Otter *Lutra lutra* (L.), a craniometric investigation

By
CHR. HYSING-DAHL

A.S JOHN GRIEGS BOKTRYKKERI
BERGEN

POLAR
PAM
3740
POLARPAM

LIBRARY
BOREAL INSTITUTE

PAM 599.742.4 : 591.134

UNIVERSITETET I BERGEN
ÅRBOK 1959
Naturvitenskapelig rekke
Nr. 5

The Norwegian Otter *Lutra lutra* (L.), a craniometric investigation

By
CHR. HYSING-DAHL

A.S JOHN GRIEGS BOKTRYKKERI
BERGEN

Received for publication October 24th 1958

LIBRARY
BOREAL INSTITUTE

CONTENTS

I. PREFACE 5

II. INTRODUCTION 5

III. MATERIAL 6
  A. *Recent skulls* 6
  B. *Subfossil skulls* 11

IV. TECHNIQUE 11
  A. *The measurements* 11
  B. *Statistics and calculus* 16

V. RESULTS. 17
  A. *Differences between the sexes*... 17
  B. *Subfossil skull-fragments compared with recent skulls*.. 21
  C. *Recent Norwegian otters compared with recent otters from other European countries* 25

VI. DISCUSSION 27

VII. SUMMARY 30

VIII. REFERENCES 31

IX. TABLES 33

I. PREFACE

The following work has been carried out at the Osteological Department of the Zoological Museum of the University of Bergen.

I want to express my thanks to the head of the museum, professor H. Brattström, and the manager of the Osteological Department, curator H. Olsen, for giving me the opportunity to use the osteological laboratory as well as material (identifications abbreviated to B and BM in list) and equipment therein. Especially I wish to express my sincere thanks to the latter, who has given me so much advice and encouragement during my work.

My thanks are also directed to curator P. Valeur, Bergen, dr. E. Sivertsen, Trondheim, dr. L. R. Natvig, Oslo and curator B. Christiansen, Tromsø, for lending me material from private collections or collections entrusted to their care. (Identifications given as Valeur, Trh., O. and T. respectively.)

I am also indebted to assistant J. O. Hannisdal and the staff of the punching-card department of the Geophysical Institute in Bergen for assistance as to the calculus of statistical parameters, and also to my friend professor C. L. Godske with whom I have discussed problems of statistical nature.

Thanks are also directed to assistant A. Frøland of the Institute of Marine Research, Fisheries Directorate, for his assistance in cutting several teeth for age-determining purposes.

Technical drawings have kindly been provided by the Zoological Laboratory.

Economic support has kindly been granted me from Det vitenskapelige forskningsråd av 1919 (The Scientific Research-fund of 1919).

Most grateful I am, however, to my wife who has taken active part in the work by controlling every statistical test which I have used.

II. INTRODUCTION

The Norwegian otter has not been made subject to any thorough craniometric research before. Collett (1911) states the range of the skull-length to be between 108 and 120 mm, which is in accordance with what I have found concerning the profile-length.

Miller (1912) has measured a few Norwegian otters, but find nothing particular about these compared to European ones.

The following work has been concentrated upon the following problems:

1. To enlarge the knowledge of the Norwegian otter especially as to skull-building, taking the results of my work upon the Norwegian badger (1954) into consideration.
2. To look for sexual differences in the skull-measurements, regarding here especially the results obtained by Hooper and Ostenson (1949) concerning the American otter *Lutra canadensis* (Schreb.).
3. To compare the skull-measurements of the Norwegian otter with those found on Danish otters by Degerbøl (1933), and cranial measurements from other works (Miller 1912, Pohle 1919).
4. To compare subfossil skulls from Norway with subfossil skulls from Denmark (Degerbøl 1933), and also to compare subfossil skulls with recent material.

III. MATERIAL

A. Recent skulls.

The material at hand when the investigation started was 71 skulls of *Lutra lutra* (L.) 54 of these were from Norway, but only 52 had further information about the locality. The geographical distribution of the latter is given on fig. 1. As will be seen from the map, the material is distributed all over the coast of Norway from the Oslofjord to the extreme north of the country. (From the Hardangerfjord there are quite a big number of skulls. The reason is that here lives a hunter, Helge Aasen, who has saved the skulls of his prey for scientific research by sending them to the University of Bergen.)

The question immediately rising, is whether this material can be said to be homogeneous, or if there are systematic differences in it which may be due to geographical isolation and thereby subspecification.

It seems to be a general assumption, however, that the otter is able to migrate rather long distances (Collett 1911, Lönnberg 1923, Johnsen 1947, Bræstrup 1949), and as water, and to a certain extent temperature, are not barriers to the migration, I think it would be rather artificial to divide the distribution-area in Norway into smaller patches.

Some authors (Melchior 1834, Collett 1911, Olstad 1945) point out that there is a difference between otter from fresh- and salt- water localities. Collett (1911) states that the otters from rivers are smaller and have a softer and darker fur than have the 'ocean-otter' as he calls the animals from the coast. Bræstrup (1949) considers this to be an assumption which needs further investigation to be confirmed.

In my material I have 10 skulls from localities where the animals certainly must have lived in rather fresh water, but not necessarily rivers (5 males and

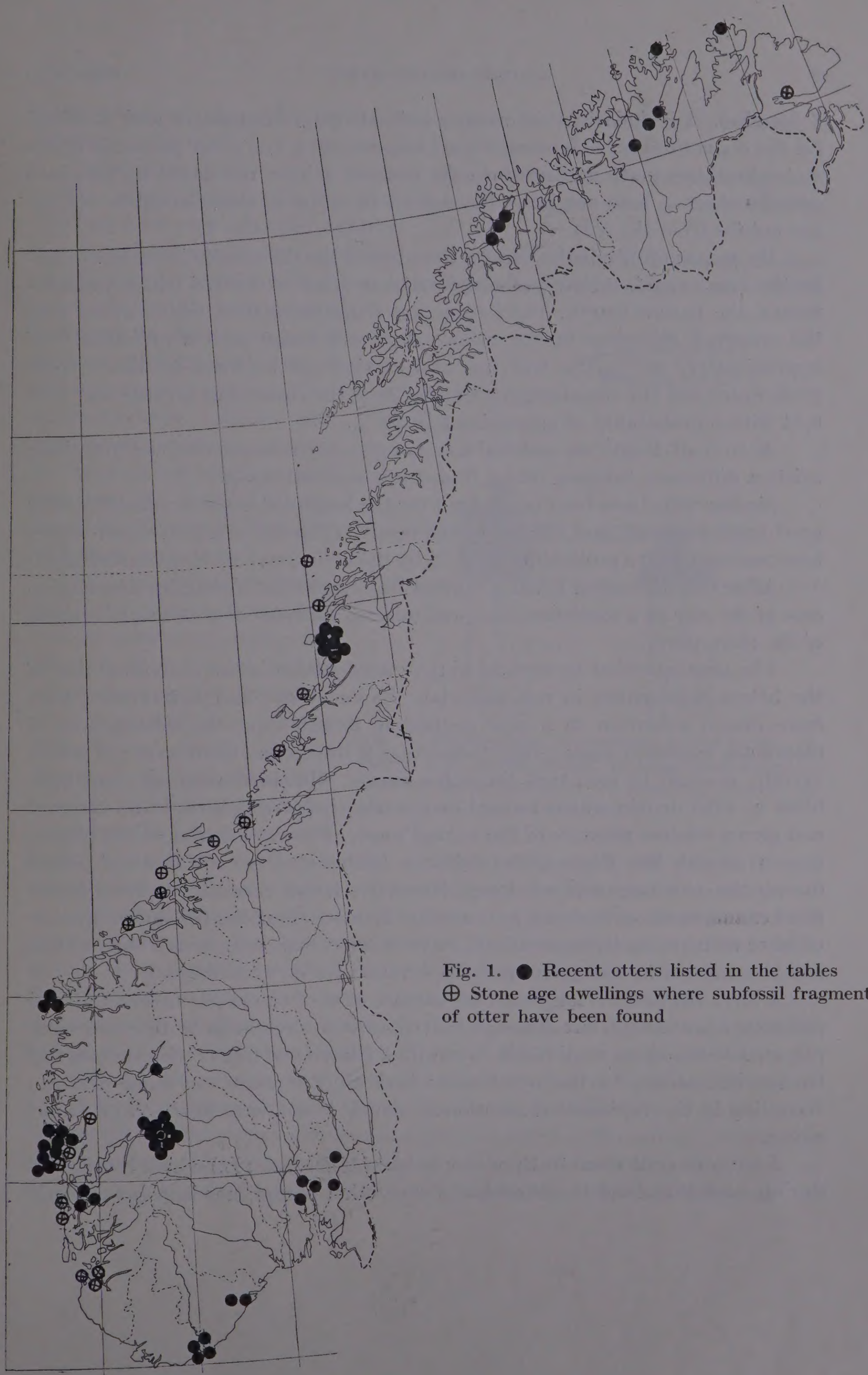

Fig. 1. ● Recent otters listed in the tables
⊕ Stone age dwellings where subfossil fragments of otter have been found

5 females). I include in this number animals from Kaupanger and Eidfjord (in the Sognefjord and Hardangerfjord respectively), but other probable fresh-water localities south and north in the country I have not dared to take into consideration as I do not know for certain the type of these localities. (They are not far from the sea).

By means of 'Student's t-test I have tested the differences in mean- values for the 5 males against the remaining 9 males as to one of the basic skull-measurements, the basilar length. The t-value was found to be 0.99, which shows that the observed difference in the mean-values will occur with a probability of approximately 30 %. The test was also carried out between 4 females from fresh-water and the remaining 15 females from the coast. The t-value was here 0,84 with a probability of approximately 40 %.

As to skull- length *my material* does not give any reason to believe that there exists a difference between otters from fresh and salt water.

Similar tests have been carried out for the length of lower carnassial, a very good tooth-measure, and with the same result. (The difference in mean-values here occurred with a probability of 15 % by the males, and 80 % by the females.)

After this discussion I find it correct to *consider the Norwegian distribution area of the otter as a continuous one, and take my material as a sample of random of the otters there.*

The next question to be taken into consideration is the individual age of the otters represented in my material. LAWS (1952) and SCHEFFER (1950) have drawn attention to a new method in determining the relative age of mammals, especially seals. They found that if the canine teeth were cut transversely, it could be seen that the pulpa cavity, with increasing age, had been filled in with dentin which formed concentric circles which could be counted and give a relative measure of the animal's age. The explanation of this phenomenon in seals like *Phoca groenlandica,* is that they have a starvation period during the moulting and whelping. However, LAWS remarks that: 'a superficial examination of material in museums indicates that the teeth of a number of other vertebrates, living and fossil, have internal rings or external ridges which, like those found in seals, may possibly be used for determining age.'

I have cut and investigated the canines of 6 of the skulls in my material (differing age and sex), but although thin concentric circles can be observed some places, I found them so difficult to see that I have not found them reliable as to age indicating. As the otter seeks food all the year, anything definite, according to the explanation mentioned above, is not very likely to be found either.

I have also cut some teeth of the badger (*Meles meles* L.) which hibernates during wintertime and therefore has a starvation period, nor in these animals have I, however, been able to find the zones which so clearly can be seen in the canines of the seals.

Sivertsen (1954) has emphasized the use of suture-closure as to age-indicating in seals, but in the Mustelid family the sutures close so early that the method is of very limited usefulness.

As I have not been able to find any exact method, the problem has been to decide whether an animal has been 'adult' or not. The characters used to determine whether the crania have belonged to fully grown up animals or not, are some of those currently employed by mammalogists, namely, the amount of closure of sutures, the prominence of ridges and processes for muscle attachment, the density and solidity of bones, and so on.

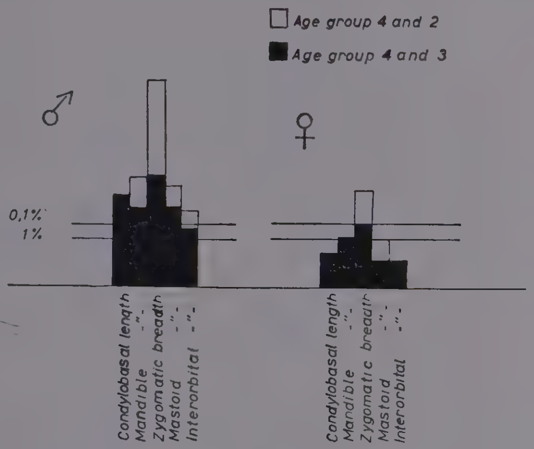

Fig. 2. Each column corresponds to the t-value obtained, after having tested the meanvalue difference between the age-groups in the sample of Hooper and Ostenson

I have remarked (1954) that the mammalian skull changes very much during the life-time of an animal, but at a certain age the animal is grown-up, and the further changes — except senility changes — in the skull may not affect the skull-measurements. Consequently I have excluded from the ordinary skull-measuring, animals which were not adults. If such animals had completed the tooth-change, I have used the tooth-measures.

However, Hooper and Ostenson have in a paper from 1949 showed the age-variation of a few skull-measures of *Lutra canadensis* (Schreb). After having grouped their excellent material in four age-groups, they have tested the difference between the sexes within each group. Four of the five skull-measurements which they consider, show that 'males are slightly more variable and significantly larger than females'. 'This size-difference is progressive with age.'

What is of special interest to me, however, is whether there are differences in the skull-measures between the age-groups of the same sex. I have therefore tested the differences between age-group 2 and 4 of the material of Hooper and Ostenson. (Age-group 1 consists of so young animals that they have no interest in this connexion). Hooper and Ostenson say that in their material age-group 2 probably includes animals from 10 to 15 months of age. Age-group 4 is composed of animals older than four years.

Between these two groups I have found a significant difference in all five skull-measures by the males, while the females show such difference in three measures only (see fig. 2).

Age-group 3 consists of the third- and fourth-year classes. Between age-group 4 and 3 I have found similar significant differences (see fig. 2). This is rather important as HOOPER and OSTENSON have found the breeding animals to be within these two age-groups — and as adults in zoology are defined as animals which are able to reproduce — *it is hereby demonstrated that the skull of Lutra canadensis* (SCHREB.) *changes with age after the animals are fully grown-up.*

This supports the view of POHLE (1919) who remarks about the growing of otter-skulls: '— das Wachstum selbst aber hört noch nicht auf, ja es scheint überhaupt während des ganzen Lebens nicht aufzuhören, vielmehr scheint der Schädel noch dauernd grösser zu werden'.

It would have been of extreme interest if the good material of HOOPER and OSTENSON could have been tested in a similar way with other skull-measures, especially tooth-measures.

As to the latter, the material of POHLE (1919) has enabled me to make a brief investigation of this problem in *Lutra lutra* (L.) His comprehensive work of the Lutrinae comprise an analysis of the skull-growth by *Lutra*, and accordingly his measuring tables contain the measures of 20 skulls of juveniles in which the breadth of $\underline{\text{P. 4.}}$ (no. 36), greatest diameter of $\underline{\text{M. 1.}}$ (no. 38), length of lower carnassial (no. 56) and breadth of lower carnassial (no. 57) could be taken.

By means of the t- test I have compared the mean-values of these measures with the remaining 40 adults of POHLE's material of true *Lutra lutra* (L.), and found the following result:

Although the mean-values of all measures were greater by the adults, the differences were so small that none of the measures mentioned above showed any differences of statistical significance whatsoever. The first two measures showed differences which have a probability of approximately 80 % to occur, the two last approximately 15 %.

It is hereby demonstrated *that the dimensions of the remaining teeth of Lutra lutra do not change with age in a similar way as does the dimensions of the skull.*

It is very probable that the result concerning the skull-dimensions of *Lutra canadensis* (SCHREB.). and the result based upon the teeth of *Lutra lutra* (L.) may also be applied to other mammals.*

* (It will not — as far as I can see — have any effect on my work upon the Norwegian badger (1954) as the material was rather homogeneous as to age, and the main results are based on tooth-measures).

If so, all comparisons based on skull-measures between populations must be considered with the utmost care as age-variation can disturb the comparisons and make false results. Tooth measures, however, seem to be of greater value.

However, in systematics it would be an almost impossible task to make comparisons between species and subspecies with material-series of the same age. We must still compare materials of 'adults' with each other, but the results obtained in this way must be carefully examined with those age-variations previously mentioned borne in mind.

B. Subfossil skulls.

Remnants of the otter are some of the most frequently occurring carnivore-bone fragments found in the kitchen-middens of Norwegian stone-age dwellings. 20 different finding-places of otter are known, two of which were insufficiently marked, and accordingly have not been used in this work (both were very small findings). The geographical distribution of the remaining 18 are given on fig. 1.

The bones have been determined by several scientists, whose names are given in the following table.

I have examined the fractures, and measured the skull-fragments which were possible to measure with my measurements.

The age of the remnants is estimated roughly from archeological works on the subject, mostly from GJESSING (1945). The age-range in the material may be rather great, but probably the measured bones all will be from 4500 years to 3 000 years of age. In spite of these deficiencies of the material — of which I am fully aware — it may still have interest to compare it with the otters living now.

(The fragments from Viste have been measured by DEGERBØL (1951), but the values given in table 3 and 4 are my measures. I found it more useful to look upon DEGERBØL's measures as a corrective, and I found our measuring results to be surprisingly like).

IV. TECHNIQUE

A. The measurements.

35 different skull-measures have been used in this work. As INGEBRIGTSEN (1923) points out, it is difficult to choose among all the measures which can be taken on mammalian skulls, their usefullness in tackling the problems being unknown beforehand.

My selection of measures has been discussed in my previous work on the Norwegian badger (1954), they being very much determined by the works of DEGERBØL (1933), and DUERST (1926). Some measurements which I then found

List of measured skulls of *Lutra lutra* (L.)

Identification number	Table-number	Sex.	Punch-card-code	Locality				Date	Age	Punch-card-code	Special informations
				County	Punch-card-code	County district	Punch-card-code				
O. 3794	323	♀	1	Akershus	3	Lørenskog	10	1862	juv./jun.	1	
O. 5243	326	♀	1	—«—	3	Ullensaker	26	Nov. 1873	ad.	5	
O. 4312	324	♀	1	Austagder	9	Flosta	6	Feb. 1865	jun.	3	÷ mandible
BM. 4404	288	♀	1	Hordaland	13	Fjelberg	4	1942	ad./jun.	4	
BM. 3919	286	♀	1	—«—	13	—«—	4	May 1923	ad.	5	
BM. 4504	290	♀	1	—«—	13	Fjell	43	June 1946	ad.	5	2 foetus
BM. 4512	291	♀	1	—«—	13	—«—	43	July 1946	ad.	5	2 foetus
BM. 4574	292	♀	1	—«—	13	—«—	43	Apr. 1948	ad.	5	3 foetus
BM. 4687	293	♀	1	—«—	13	—«—	43	June 1950	ad.	5	
BM. 4796	294	♀	1	—«—	13	—«—	43	May 1954	jun.	3	
B. 75	299	♀	1	—«—	13	Eidfjord	22	Oct. 1927	jun.	3	
B. 77	301	♀	1	—«—	13	—«—	22	Jan. 1934	ad./jun.	4	
B. 78	302	♀	1	—«—	13	—«—	22	Feb. 1943	ad.	5	
B. 79	303	♀	1	—«—	13	—«—	22	Nov. 1938	jun./juv.	2	
B. 80	304	♀	1	—«—	13	—«—	22	May 1938	ad./sen.	6	4 foetus
BM. 2962	281	♀	1	Sogn og Fjordane	14	Bremanger	29	Dec. 1917	ad.	5	
BM. 2963	282	♀	1	—«—	14	—«—	29	Dec. 1917	ad.	5	
BM. 2964	283	♀	1	—«—	14	—«—	29	Dec. 1917	ad.	5	
BM. 2413	276	♀	1	Nordland	17	Brønnøy	3	Apr. 1914	ad.	5	
BM. 2414	277	♀	1	—«—	17	—«—	3	Apr. 1914	ad.	5	
BM. 2415	278	♀	1	—«—	17	—«—	3	Apr. 1914	ad./jun.	4	
BM. 2416	279	♀	1	—«—	17	—«—	3	Apr. 1914	ad./jun.	4	
BM. 2411	274	♀	1	—«—	17	—«—	3	Apr. 1914	juv./jun.	1	

O. 4313	325	♂	2	Austagder	9	Flosta	6	1865	ad.	5	÷ mandible
Valeur 1	306	♂	2	Vestagder	10	Randesund	2	Oct. 1941	ad.	5	
Valeur 3	308	♂	2	—«—	10	—«—	2	Aug. 1941	ad./jun.	4	
Valeur 2	307	♂	2	—«—	10	Søgne	8	Aug. 1943	ad.	5	
BM. 4407	289	♂	2	Hordaland	13	Fjelberg	4	1942	ad.	5	
BM. 3911	285	♂	2	—«—	13	Haus	40	Nov. 1923	ad.	5	
B. 71	295	♂	2	—«—	13	Eidfjord	22	Mar. 1943	ad.	5	
B. 72	296	♂	2	—«—	13	—«—	22	Mar. 1943	jun.	3	
B. 73	297	♂	2	—«—	13	—«—	22	Mar. 1943	ad.	5	
B. 76	300	♂	2	—«—	13	—«—	22	1942	ad.	5	
BM. 3062	284	♂	2	Sogn og Fjordane	14	Sogndal	8	Apr. 1919	ad.	5	
BM. 2410	273	♂	2	Nordland	17	Brønnøy	3	Apr. 1914	ad.	5	
BM. 2412	275	♂	2	—«—	17	—«—	3	Apr. 1914	ad.	5	
BM. 4136	287	♂	2	Vestlandet	—	—	—	Feb. 1928	ad.	5	
O. 7616	332	?	0	Akershus	3	Nesodden	6	1926	ad.	5	
O. 7332	331	?	0	—«—	3	Bærum	13	1897	jun./juv.	2	
O. 7329	328	?	0	Buskerud	6	Lier	18	Feb. 1909	juv./jun.	1	
Valeur 4	309	?	0	Vestagder	10	—	—	—	ad.	5	
BM. 288	271	?	0	Bergen	12	—	—	—	ad./jun.	4	
BM. 2762	280	?	0	—«—	12	—	—	—	ad./jun.	4	
B. 74	298	?	0	Hordaland	13	Eidfjord	22	Jan. 1933	juv./jun.	1	
O. 7722	333	?	0	—«—	13	Herdla	44	Feb. 1935	jun.	3	
Trh. 263a	313	?	0	Troms	18	Tromøsund	28	1892	ad.	5	
Trh. 263b	314	?	0	—«—	18	—«—	28	1892	ad.	5	
Trh. 263c	315	?	0	—«—	18	—«—	28	1892	ad./jun.	4	
T. 218	317	?	0	Finnmark	19	—	—	—	ad.	5	
T. 217	316	?	0	—«—	19	Kistrand	8	—	ad.	5	
T. 374	318	?	0	—«—	19	—«—	8	—	ad.	5	
O. 7331	330	?	0	—«—	19	Måsøy	9	1907	jun./juv.	2	
O. 7328	327	?	0	—«—	19	Lebesby	11	Aug. 1911	ad.	5	
O. 2836	321	?	0	—	—	—	—	1856	ad.	5	

LIBRARY
BOREAL INSTITUTE

List of subfossils.

Name of Dwelling	Cat. No.	Locality		Number of skull-fragments	Skullfragments which could not be measured	Estimated age	Determined by
		County	County district				
Hellesøy	216	Rogaland	Hetland 17	0	—	Young stoneage	Brinkmann
Kverneviken	111	—«—	—«— 17	0	—	Stoneage	Winge
Viste I	112	—«—	Randaberg 16	8	Canines 3, Incisives 1, maxillar fragm. 1	Old stoneage	Brinkmann
Viste II		—«—	—«— 16	21	Canines 4, Premolars 1, Temporalfragm. 1, Occipitalfragm. 1, height: 31,9 mm	—«—	Degerbøl
Osterbakjen......	257	Hordaland	Bømlo 10	5	Canines 1, Incisives 1, Mandibularfragm. (juv.) 2	Ironage	Olsen
Rundøyno	199	—«—	—«— 10	1	Canines 1	Young Stoneage	Brinkmann
Gjeitalemen	148	—«—	Sund 32	0	—	—«—	—«—
Ruskenes II	1	—«—	Fana 33	24	Canines 4, Incisives 2, Bulla tymp. 2, mandibular fragm. 1, maxillar fragm. 2	Stoneage	—«— (Winge)
Ruskenes I	1	—«—	—«— 33	9	Canines 1, Incisives 2	—«—	—«—
Skipshelleren	258	—«—	Bruvik 35	66	Canines 9, Incisives 2, Carnassial 2, Mandibularfragm. 11, Maxillarfragm. 6	—«—	Olsen
Sauehelleren	6	Møre og Romsdal	Nord-Aukra 40	1	—	Stone- or Ironage	Winge
Laksevågen I	16	—«—	Frei 52	0	—	Stoneage	Brinkmann
Laksevågen II ...	153	—«—	—«— 52	3	Frontalefragm. 1	Iron- or stoneage	—«—
Hallerøy.........	193	—«—	Bratvær 55	1	—	?	—«—
Hestneshulen	5	Sør-Trøndelag	Sandstad 19	3	Mandibularfragm. 1, (juv)	Stone- or ironage	Winge
Dalen	9	—«—	Rissa 8	1	—	Young stoneage	—«—
Absalonhelleren ..	10	Nord-Trøndelag	Flatanger 38	0	—	Stoneage(?)	—«—
Solsemhulen	8	—«—	Leka 42	3	Bulla tymp. 1. Palatinum 1	?	—«—
Åkvik	14	Nordland	Dønnes 15	4	—	Young stoneage	—«—
Træna...........	260	—«—	Træna 25	13	Mandibularfragm. 1	Stoneage	Olsen
Advik	349	Finnmark	Nesseby 17	0	—	North-norwegian stoneage	—«—

to be of limited value, I have dropped out of the present work, (nos. 15, 16, 23, 24, 41, 44, 45, 47, 52, 53) and some have been changed (nos. 37, 38, 39, 51).

The measuring procedure has been the same as in my work from 1954, the instruments too.

The following measurements have been taken, definitions mostly according to Duerst (1926). Tooth-measures have been taken as crown measures except no. 49, length of premolars in the mandible.

The numbers of the measures have been kept as in my work from 1954, so as to make comparisons easier.

Calvarium

7. Profile-length, Prosthion — Opistokranion.
8. Condylobasal-length, Prosthion — Condyli occipitales.
9. Basilar-length, Degerbøl: Basal-length, Prosthion — Basion.
10. Length of inner brain-case, Basion — Lamina cribosa. (Taken according to Wagner 1929).
11. Basion — Middle of frontal. (Middle of frontal according to Brinkmann 1920, where a line between the two processi postorbitales cuts the median plane).
12. Middle of frontal — Prosthion.
13. Length of rostrum. (Not corresponding to the lateral length of face as defined by Duerst 1926).
14. Palatal length, Prosthion — Staphylion.
17. Zygomatic breadth.
18. Mastoid breadth.
19. Breadth of brain-case.
20. Breadth between processi postorbitales.
21. Postorbital constriction.
22. Interorbital constriction.
25. Breadth of rostrum over canines.
26. Palatal depth, Postdentale — Middle of frontal.
27. Occipital depth, Basion — Opistokranion.
34. Length of maxillary tooth-row, (Premolars and Molars).
35. $\underline{\text{P. 4.}}$ length.
36. $\underline{\text{P. 4.}}$ breadth.
37. Length of talon of $\underline{\text{P. 4.}}$
38. $\underline{\text{M. 1.}}$ greatest diameter.
39. $\underline{\text{M. 1.}}$ length.

Mandible

40. Total length, Infradentale — Gonioncaudale.
42. Height of processus coronoideus, Gonion ventrale-Coronion.
43. Depth of ramus horisontalis between $\overline{\text{P. 4.}}$ and $\overline{\text{M. 1.}}$
46. Greatest thickness of ramus horisontalis under $\overline{\text{M. 1.}}$
48. Length of mandibular tooth-row, (Premolars and Molars).

49. Length of premolars. (This measure is taken as an alveolus measure.)
50. Length of molars.
51. Greatest diameter of $\overline{\mathrm{M.\,2.}}$
54. $\overline{\mathrm{P.\,4.}}$ length.
55. $\overline{\mathrm{P.\,4.}}$ breadth.
56. $\overline{\mathrm{M.\,1.}}$ length.
57. $\overline{\mathrm{M.\,2.}}$ breadth.

The results of these measurements are given in the tables 1 and 2 for the recent otters, in the tables 3 and 4 for the subfossil fragments. If uncertain measuring points, or, what is common for subfossils, alveolus-measures have been used (the last point has been worked out by DEGERBØL 1933), the numbers in the tables are marked by an asterisk.

B. Statistics and Calculus.

The following statistical parameters and tests have been employed in this work:

($\bar{x}$) Mean, defined by $$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

(σ^2) Variance, defined by $$\sigma^2 = \frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2$$

(r) Correlation coefficient, defined by $$r = \frac{\frac{1}{n}\sum_{i=1}^{n} x_i y_i - \overline{xy}}{\sigma_x \sigma_y}$$

t-test after the formula $$t = \frac{\bar{x} - \bar{y}}{\sqrt{n_x\sigma_x^2 + n_y\sigma^2_y}} \; \frac{\sqrt{n_x n_y (n_y + n_x - 2)}}{n_y + n_x}$$

FISCHERS *table for testing the significance of correlation-coefficients.*

FISCHERS *transformed correlations.* (Testing the difference between two correlation-coefficients).

As in my work from 1954, the table-numbers have been listed by a punch-card-machine, and the statistical parameters ($\bar{x}$, σ^2) calculated by an I.B.M. calculating punch type 602 A. The measurements have therefore been transferred to punching cards after the same pattern as used in that work, that pattern being just slightly modified. The columns in the punch-card corresponding to cancelled measurements have not been used. Attention should be drawn to measurements no. 37 which in this work means the length of the talon of $\underline{\mathrm{P.\,4.}}$ instead of greatest length of $\underline{\mathrm{M.\,1.}}$ which here is transferred to no. 39.

V. RESULTS

A. Differences between the sexes.

By means of 'student's' t-test, the mean-values of all skull-measurements of Norwegian female otters are compared with the corresponding descriptive measures of the males. In fig. 3 a diagram is given, showing the t-values obtained after having tested the differences between the mean-values. The two lines drawn parallell to the x-axis give the 1 % and 0.1 % level (for the corresponding degrees of freedom).

As shown on the diagram, all length-dimensions of the skull are greater by the males than by the females. (Measures nos. 7, 8, 9, 10, 11, 12, 13 and 14). As to the breadth-measures, the main breadth-measures show the same as the length-measures (measure no. 17 zygomatic breadth, no. 18 mastoid breadth, no. 19 braincase breadth), but the breadth-dimensions of the region around the eyes are more uncertain. Of interest is the lack of difference between the sexes as to the breadth between the processes postorbitales (measure no. 20), points of muscle attachment which usually are subject to sexual dimorphism (The badger for example).

The postorbital constriction (measure no. 21) is the only measure in which the females show greater mean-value than the males. This is what might be expected as this region narrows with age, presumably due to muscle increase, an increase which seems to start earlier in males than in females by many mammals. How the bones actually change with age in this region have been worked out by Pohle (1919). This does not match with the result which I found on the Norwegian badger (1954) in this respect, but in my opinion the badger shows here the aberration. Before more species of the mustelid family have been investigated, it is difficult to say how these differing results concerning these two animals may be explained. The interorbital constriction (measure no. 22) does also show an uncertain difference between the sexes, a result which is in accordance with what other scientists have found (Hooper and Ostenson, Pohle and others). I will return to this point later.

The rest of the skull-measures (breadth and depth measures) of the calvarium show all the same tendency, a significant difference between the sexes.

The most surprising result concerns, however, the teeth. As I have shown (1954), the tooth-measures of the Norwegian badger are not subject to sexual dimorphism. But the otter does not follow this pattern. All tooth measures of the calvary (except perhaps for no. 35, length of $\underline{\text{P. 4.}}$) are significantly greater by the males than by females. So are the tooth-measures of the mandible except for the length and breadth of $\overline{\text{P. 4.}}$ (Measures nos. 54 and 55). It is however, doubtful whether these last two measures can be said to have decisive import-

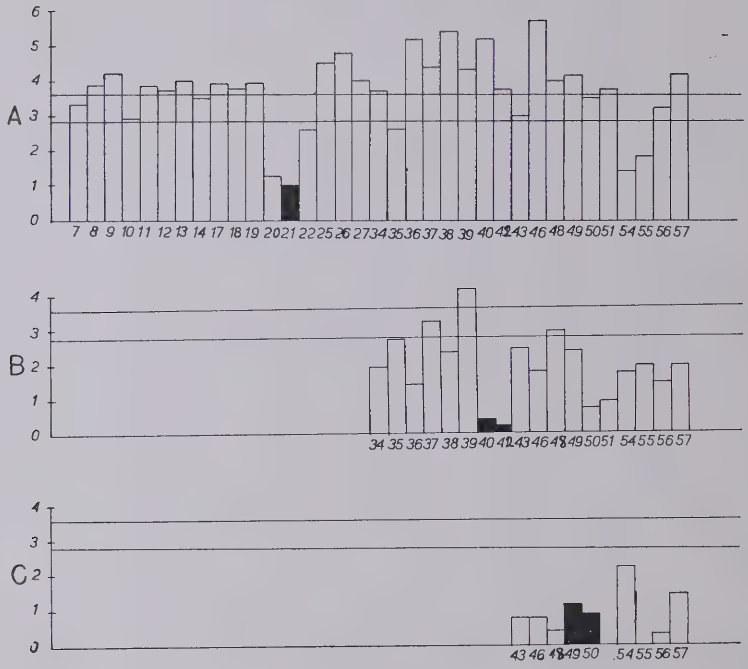

Fig. 3. A. Each column corresponds to the t-value obtained, after having tested the mean-value difference between Norwegian male and female skull-measurements. (Black columns mean that the female had greater mean than the male)
B. A similar comparison between Norwegian subfossil and recent skull-measurements. (Black columns mean that the recent otter had greater mean than the subfossil)
C. A similar comparison between Norwegian subfossil and Danish subfossil skull-measurements. (Black columns mean that the Danish subfossil had greater mean than the Norwegian)

ance, the length of $\overline{\mathrm{P.\,4.}}$ is to a certain extent also included in the premolar-length (measure no. 49) which shows significant difference between the sexes. It might be explained if the premolars had been placed more oblique in the mandible of the females, but by eyesight this seems not to be the case. It should also be noted that these dimensions are very small and the accuracy of the measuring-procedure the same for all measures and that may naturally affect the small measures.

Measure no. 46, the thickness of ramus horisontalis of the mandible shows the greatest t-value. The distribution of this measure is given on fig. 4. Next to this comes measure no. 38, greatest diameter of $\underline{\mathrm{M.\,1.}}$, the distribution of the material as to this measure is given on fig. 4 too. On this fig. is also given the distribution of the part of my material which is not sex-determined. Some

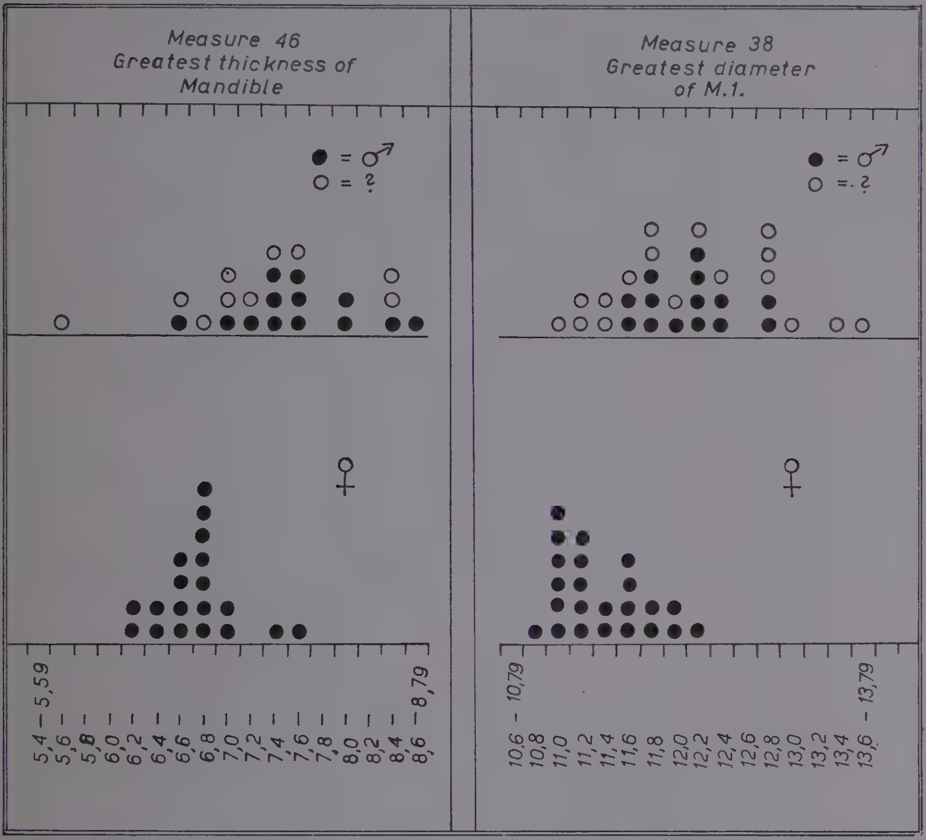

Fig. 4. Distribution of two measures which show clear sex-dimorphism

of these animals are seen to be on the male side of the distribution area, some on the female side, and some in between. I have made similar diagrams for 18 measures that showed sex differences clearly, and plotted the un-sexed material too. I have then counted how many times an un-sexed animal was on the male side of the diagram — that is : greater than the greatest female, and how many times an animal was on the female side — that is: smaller than the smallest male.

The result of this is given on fig. 5. From this figure it is quite obvious that some of the animals most certainly must have been males (nos. 271, 317, 316, 318, 330), and some females (nos. 309, 280, 314). Yet there are several skulls

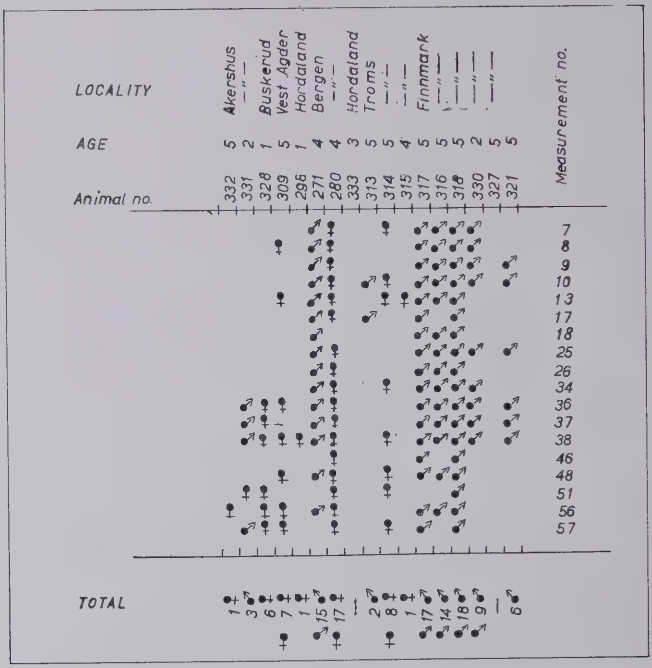

Fig. 5. The result of a test (explanation in text) with the part of my material which was not sex determined

which show an intermediate position. I have not found any certain method of sex-determining isolated skulls, apart from the unsufficient methods mentioned above.

The question which quite naturally rises is whether the greater male skull is just a conform increase of the smaller female skull. As to length- and depth-dimensions of the calvarium fig. 6 shows clearly that this seems to be the case. As to breadth-dimensions, the differences of the measures of the region around the orbit are not of proportionate greatness, so that the general shape of the female brain-case does not seem so compressed as that of the male.

This is in accordance with the result of Hooper and Ostenson concerning *Lutra canadensis* (Schreb). They also found that this region (represented by the interorbitral breadth (measure no. 22) in their work) did not show any clear difference between the sexes. They say: 'It seems reasonably clear that much of the variation in interorbital diameter is that occurring among individuals irrespective of sex or age'. Latimer and Riley (1934) and Latimer (1937) have found corresponding results on the muskrat *Ondatra zibethicus cinnamominus* and the skunk *Mephitis mesomelas avia*, while the badger *Meles meles meles* does not follow this pattern (Hysing-Dahl 1954).

The aberrant relations of the orbital region may have connexion with the growing of the skull which is investigated by Pohle (1919). He points out that here is a border of resorption: 'Fast die ganze äussere Oberfläche des Stirnbeinteiles der an der Bildung der Gehirnkapsel beteiligt ist hat ein schwammiges Aussehen, ein Zeichen, dass hier starke Resorptionen vorgingen . Es beginnt dieser rauhe Teil der Oberfläche genau hinter dem entstehenden Proc. postorb. *Der Teil davor ist glatt, er wächst eben nur durch Apposition weiter.*' (Underlining by me).

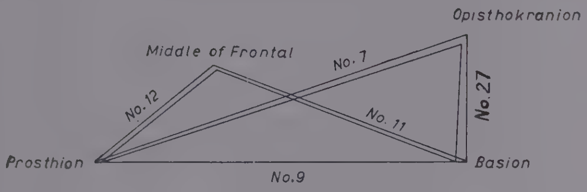

Fig. 6. The mean-values of five skull-measurements in the sagittal plane drawn on the same figure to show the conformity between male and female skulls. (Male: outer line)

Pohle has also drawn attention to 'einer schwachen Geschlechtsdimorphismus' in the skull of *Lutra lutra* (L.), while he does not remark anything about *Lutra canadensis* (Schreb).

The result of this investigation of the influence of sex upon the skull-building of the Norwegian otter *Lutra lutra* (L.) may to some extent, be in accordance with what has been found on *Lutra canadensis* (Schreb.) and may be summarized as follows: *Considered as groups the skulls of Norwegian male and female otters seem to differ from each other as the skulls and teeth of the males are heavier built than those of the females. Concerning the lenght and heigth of the calvary this difference seems to be conform, but as to breadth around the orbit, the female otters are relatively broader than are the males.*

B. Subfossil skull-fragments compared with recent skulls.

From the facts mentioned above, it is quite clear that comparisons between mixed male and female materials are doubtful. It is, however, (by any method known to me) impossible to decide whether subfossil fragments have belonged to a male or a female animal. If we therefore wish to investigate the problems of evolution-tendencies in the skull of mammals during the last 2—3 000 years, we have to cope with mixed material on the subfossil side anyhow. (Until a sex-determining method might be found).

If mixed materials are used, it is necessary that the proportion between males and females is approximately the same in the two samples. It is obvious that a comparison between two mixed materials, one of which consists of 80 % males, the other of 80 % females will give false results.

Johnsen (1947) states that there seems to be more male otters in a litter than females, but he does not go into details about this question.

Hooper and Ostenson (1949) have got 90 males of *Lutra canadensis* (Schreb.) and 49 females in their collected material. They point out that these numbers may give an erroneous impression of the relation between males and females in nature, but anyhow they match with Johnsen's statement concerning *Lutra lutra* (L.). This difference in number is noteworthy when we are going to look at different groups of mixed material.

In fig. 3 B is given a similar diagram to that in fig. 3 A, and it will be seen from this that — with two exceptions — the dimensions of the subfossils are greater than the recent ones, but only a few tooth-measures show statistical significances.

The only two measures where the recent animals shows greater meanvalue than the subfossils, are length of mandible (no. 40) and heighth of processus coronoideus (no. 42). This is very easy to explain as the measuring points of these dimensions very often have been weared during the subfossil's long stay in soil, and accordingly the measured dimensions are too small.

Now, if the subfossil material is composed of more males than females the measurements of these will naturally be greater than those of the recent otters where the numbers are 14 + 5 males (the 5 determined on page 19) against 23 + 3 females (the 3 determined on page 19), and 9 not sex-determined. But if so, we should expect the measures which show the greatest sex-dimorphism to show the greatest differences between fossils and recent material too. This is not the case. If we consider measure no. 46, greatest thickness of mandible, no. 38, M. 1. greatest diameter, and no. 36, breadth of P. 4., we find that these measures by far show the most significant differences between the sexes. The same measurements show, however, very uncertain differences between subfossil and recent otters. This seems to indicate that the differences between subfossil and recent material are not due to the composition of materials as to sex, but may have another explanation.

Considering fig. 3 B we find the following measurements to be of interest: Tooth-measures of the maxilla: no. 35, length of P. 4. no. 37, P. 4. talon-length, no. 39 M. 1. greatest length, and these dimensions of the mandible: no. 48, mandibular tooth-row, and to a lesser extent no. 49 length of premolars and no. 43, depth of mandible.

It is very interesting to see that the hindmost teeth of the maxilla P. 4. and M. 1. are considerably longer by the subfossils than by the recent otters. This hypothesis holds even if the degrees of freedom are being reduced to 11, which must be the lowest possible number of subfossil animals in the material (regarding this measure) namely if we believe that as many fragments as possible are left and right side of the same individual.

Even a comparison between the subfossil material and the recent *males* gives a rather high t-value for measure no. 39, greatest length of $\underline{\text{M. 1.}}$ Only in 8 % of all cases such a t-value may occur.

Before drawing any conclusions from these facts, let us consider the comparison between Norwegian subfossil and Danish subfossils from the work of DEGERBØL (1933). (His sample of subfossils from the stoneage). Here the few measures that can be compared are all from the mandible. I have used all measures which DEGERBØL and I have both been able to take, but attention should be drawn to no. 54, length of $\overline{\text{P. 4.}}$ and no. 55, breadth of $\overline{\text{P. 4.}}$ The two samples can not without hesitation be compared as to these measures for the following reasons: DEGERBØL has measured the length of $\overline{\text{P. 4.}}$ of 20 fragments, but 5 of these were alveolus measures. I have measured 22 fragments of which none is alveolus measure. As will be seen from fig. 7 the difference between alveolus and tooth-crown measure is rather great in $\overline{\text{P. 4.}}$

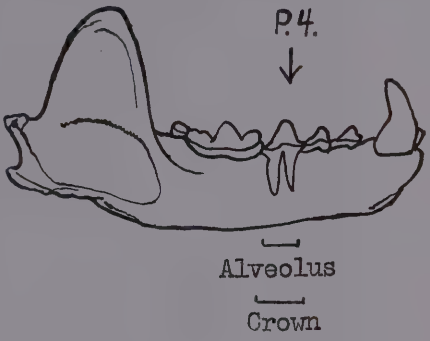

Fig. 7. Mandible of otter with the roots of P.4. indicated

If the 5 alveolus measures of DEGERBØL's sample are taken out, the comparison between the Norwegian and the Danish subfossils shows no difference of statistical significance for this measure.

As to the breadth of $\overline{\text{P. 4.}}$ I have found a t-value = 2.97, but as remarked before (page 18) the dimension itself and the measuring accuracy put a limit to the reliability of this value.

As will be seen from fig. 3 C, then none of the compared measures show any significant differences, neither is one sample systematically larger in all measures.

This seems to justify the following conclusion:

There seems to exist no difference between the subfossil otters from Norway and Denmark.

I have not used these two materials together as the material of DEGERBØL is smaller and measured with fever measures than my sample.

The result of this investigation about the recent and subfossil otter-crania seems to point in the direction that this animal has followed the general evolution-tendency of most of the Scandinavian mammals: a decrease in greatness from the stone-age to our days.

As this result is based upon sensitive statistical criteria concerning the *mean-values* of different measurements, it would be quite wrong to make any subspecification of these groups of animals. The t-test tells us that there exists a significant difference between some of the mean-values, but these differences are in this case certainly not of such greatness that they justify a subspecies. (See Hysing-Dahl 1954 about *Meles meles danicus* Degerbøl with t-values greater than 15).

I should like to draw attention to another point, namely measurement no. 38 greatest diameter of M. 1., and no. 39, greatest length of the same tooth. No. 38 shows a greater sex-dimorphism than no. 39, but no. 39 shows a much bigger difference between subfossils and recent otters than no. 38. does. This might be due to following:

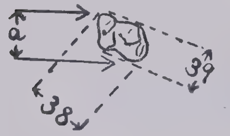

Fig. 8. M.1. of the maxilla with the position of some measures

The bigger the sex-dimorphism — the bigger the variance of the total material for this measure. This bigger variance influences then the comparisons of mixed materials.

However, another explanation may be a better one:

I have calculated the correlation-coefficient between these two measures for recent Norwegian material and for subfossil Norwegian material. The coefficient was found to be 0,80 and 0,63 respectively. This seems to indicate that M.1. of the maxilla- see fig. 8 — has been fixed as to breadth by the subfossils, but the length- presumably due to better room in the maxilla — was allowed individual variation. By the recent otter however, the general decrease in greatness has reduced this room for individual variation in length, and the two measures must variate together more closely than was the case by the subfossils. However, by means of the logarithmic transformation of correlation-coefficients (Fisher), the difference between these two correlation-coefficients was not found to be statistically significant.

This theory can therefore only be confirmed — or rejected — by further research, especially if the sample of subfossils could be increased.

The conclusion of these investigations may be given in this way:

As to skull-building and tooth-dimensions the otter which lived in Denmark and Norway 3 000—4 000 years ago seems to have been of the same type.

It seems that a decrease in greatness — the general tendency of evolution shown by many Scandinavian mammals during these 3 000—4 000 years — to a certain extent also has been followed by the otter.

C. Recent Norwegian otters compared to recent otters from other European countries.

In fig. 9 is given a diagram showing the t-values obtained after having tested the differences in mean values between my material and recent Danish otters measured by Degerbøl (1933). I have dropped out the juveniles and juniors in his tables when I calculated the parameters given as group 4 in tables 5, 6 and 7.

From fig. 9 A it is seen that for 10 measures the Norwegian material has the greatest mean values, and for 13 measures the Danish material shows the greatest mean values. None of these differences are statistically significant.

The mean values of two measures (No. 37 and No. 49) listed in the tables can not be compared for the following reasons:

No. 37 is length of talon of P. $\underline{4}$. the measuring points of which are very difficult to define exactly, and accordingly this measure can not (with any certainty) be compared between two samples measured by different scientists.

No. 49 is length of premolars which I have measured as an alveolus measure, (see page 16). Degerbøl has taken all tooth-measures as crown-measures.

It should therefore be clear that there does not seem to exist any differences between the skull- and tooth- dimensions of recent otters from Denmark and Norway.

In fig. 9 is also given a similar diagram showing the result of the comparisons between the Norwegian material measured by me and the material from different European countries which was measured by Miller (1912). In his tables are also listed a few Norwegian otters which I did not take out when I calculated the parameters given as group 5 in the tables, as they will influence the parameters very little, and I wanted to have the material of Miller as a whole.

From fig. 9 B it will be seen that the sample of Miller shows the largest mean values for 3 measures, and the Norwegian sample has the largest mean values for 10 measures. None of the differences between these mean values are statistically significant.

The mean values of 2 measures (No. 26 and No. 39) listed in the tables can not be compared for the following reasons:

No. 26, Palatal depth is defined in this work as the distance between Postdentale and Middle of Frontal, a line which is skew according to the palatal plane. In Miller's work the measure is called 'Palatal depth behind toothrows' and is certainly taken vertically to the palatal plane and from the border of the palate to an unknown point on the frontal.

No. 39, length of $\underline{\text{M. 1.}}$ I have taken as fig. 8 shows because I found it technically most easy, while the exact *length* of the tooth is given by *a* in the fig. and presumably is the dimension measured by Miller.

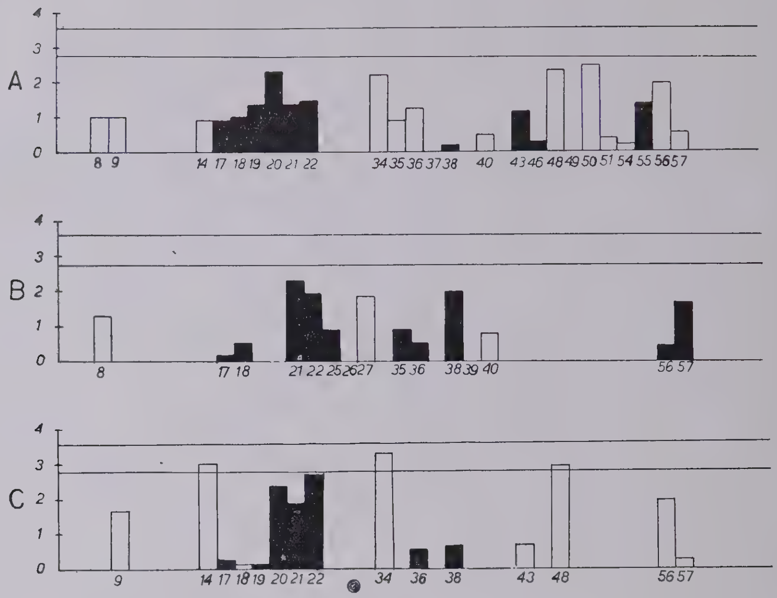

Fig. 9. A. Each column corresponds to the t-value obtained, after having tested the mean-value difference between the Norwegian sample and the Danish sample (Degerbøl 1933) of recent otters skull-measures. (Black columns mean that the Norwegian had greatest mean)
B. A similar comparison between the Norwegian sample and the material of Miller (1912). (Black columns mean that the Norwegian had greatest mean.)
C. A similar comparison between the Norwegian sample and the material of Pohle (1919). (Black columns mean that the Norwegian had greatest mean)

It should therefore be clear that there does not seem to exist any differences between the skull and tooth-dimensions of recent otters from Norway and other Western European countries represented by the material of Miller *(1912).*

Pohle, in his great work from 1919, gives skull-measures of an excellent otter material from all over the world. From his tables I have taken the measures of the animals which he considers to be the true *Lutra lutra* (L.). I have omitted the animals which were not adults. 45 skulls were then left, and as only 8 of these were determined to be males and 8 to be females, I have not taken the work to divide this material into groups, but have calculated the parameters given as group 8 in the tables for the whole material together.

In fig. 9 C is given a similar diagram as the previous, and it is seen from this that for 7 of the compared measures the Norwegian material shows the greatest mean value, while Pohle's material is greatest in 8 measures. In all length-measures Pohle's sample has the greatest mean value, and three of these measures, the palatal length (no. 14), length of maxillary toothrow (No. 34) and length of mandibular toothrow (No. 48) are statistically significant larger than the Norwegian sample. This seems to indicate that the European otter in Pohle's sample has a larger rostrum than the Norwegian, but I find it very difficult to decide whether this result may be based on different technique by Pohle and me, or whether the otters of these two districts are genealogically different. Looking at the comparison between Danish and Norwegian material, we find that the tooth-rows of the Danish sample also are a bit greater than the Norwegian, but not significantly. (May be because of the small Danish sample.) Between the Danish sample of Degerbøl and the sample of Pohle there is no significant difference as to the three mentioned measures. (No. 14, No. 34 and No. 48).

On the other hand all samples (Miller, Degerbøl and Pohle) are smaller as to the breadth dimensions around the orbit than the Norwegian material.

It seems therefore that although none of the mentioned breadth-differences are statistically significant, and the t-values of the mentioned three length measures are small, there might exist different trends in the skull building of the *Lutra lutra* (L.). These differences are, however, so small, and the results based upon comparisons that may prove to be erroneous (the materials composition as to sex and age, that different scientists may have a slightly different technique), that only future research can decide the importance of the observed differences.

For the time being my research concerning the recent otter *Lutra lutra* (L) emphasize the conclusion of Miller (1912) that: 'although the specimens show some rather noteworthy variations in colour, and in cranial and dental measurements, the animal examined is not sufficient to indicate the existence of geographical races in Europe'. (I will return to the statement of Hinton (1920) later).

VI. DISCUSSION

Turning our attention to the general architecture of the skull of the otter, we may now state the following:

The sexdimorphism is rather great by the otter, greater than was the case by the badger (Hysing-Dahl 1954). This difference concerns not only the dimensions of the skull but also the teeth. What is the reason for this difference between *Meles meles* and *Lutra lutra?*

It is well known that in mammals by whom the males fight during the mating-season the sexdimorphism is great. By species where the males gather a 'harem' as for example the fur seal *Arctocephalus gazella* (Peters), the difference between male and female is most striking. That this is so, is quite easy to understand, as only the strongest bulls then will have a chance to reproduce and give as inheritance some of their qualities. OLSTAD (1929) has found that the males are even predominant in a colony of *Arctocephalus gazella*, and the selection of nature must therefore be very much at work by these mammals, and the direction of evolution, an increase in greatness by the males, seems to have followed.

SIVERTSEN (1954) gives skull-measures of *Arctocephalus gazella* which show this big sexdimorphism in the skull-dimensions. (For example the skull-length ranges in adult males from 231 mm to 254 mm, in adult females from 183.6 mm to 208.2 mm.)

On this background a reasonable explanation of the difference between the sexdimorphism of otter and badger seems to be this:

According to JOHNSEN (1947) the badger is a very indolent animal which does not even get excited during the mating-season, and fights between the males do not seem to take place.

The otter males, however (still after JOHNSEN), have hot fights in the sea during the mating-season, and as the males, as previously mentioned, predominate in number, an evolution in the direction of stronger males seems quite natural.

SCHÄFF (1889) has pointed out a remarkable size difference between two skulls of *Lutra lutra* which were fully grown up. He says: 'Fragt man nach den Ursachen so bedeutender Grössen Unterschiede bei Exemplaren einer und derselben Art, so lassen sich für den vorliegenden Fall der Fischotter wohl mit ziemlicher Sicherheit zwei Faktoren als ausschlaggebend anführen, nämlich 1. die Verschiedenheit der Ranz — resp.— Geburtszeit und 2. Mangel oder Ueberfluss an Nahrung.'

As nothing is said about the sex of the skulls, it seems more likely to believe that SCHÄFF has had one female and one male skull at hand.

Some of his measures may be quoted together with the measures of one of the greatest male and one of the smallest female adults of my material.

	SCHÄFF	My material no. 275, 304
Basallänge	115—93	113—100
Jochbogenbreite	72.3—57	77.6—67.2
Länge des unteren Reisszahnes	14.5—12	14.2—12.2
Breite des unteren Reisszahnes	8— 6	7.1—5.7

It is seen from the table that my material gives almost the same striking difference as SCHÄFF's measures, so that the sexdimorphism of the otter may explain the whole matter.

Turning from this question of the sexdimorphism to that of the distribution and specification of otters all over the world, we find that the systematics and nomenclature of this group of animal — as OLDFIELD THOMAS already pointed out in 1889 — have been very difficult to work out.

However, the great work of POHLE (1919) has cleared up this matter, and POCOCK (1921) is mainly in agreement with him. So is ALLEN (1938) who says that 'the common otter of Europe is closely related to that of eastern Asia, and extends with little modification across northern Asia, into China, where it is represented by probably two subspecies' (*chinensis*, *nair*).

POHLE recognizes the following subspecies of *Lutra lutra* (L.):

Name	Distribution (approximately)	Skull characteristics
Lutra lutra (*lutra*) (L.)	All Europe and northern Asia from England and Spain in West to Sachalin in East. South to the black sea and Himalaya. North to the tundra.	Hauptart
Lutra lutra angustifrons LATASTE	North Africa	Der Schädel ist von dem Hauptart kaum zu unterscheiden
Lutra lutra seistanica BIRULA	From Greece east to Pakistan	None mentioned
Lutra lutra nair F. CUV.	India	Wie bei Lutra. Etwas kleiner und schmaler
Lutra lutra ceylinica POHLE	Ceylon	Er fällt durch seine geringe Grösse auf
Lutra lutra chinensis GRAY	China	None mentioned
Lutra lutra whiteley (GRAY)	Japan	Fast ganz wie der des europeischen
Lutra lutra roensis OGILBY	Ireland	Die Masse der Schädel liegen vollkommen innerhalb der Variations breite der Schädelmasse von *Lutra lutra*

As will be seen from the table above, the skull-building is the same for almost all of these subspecies, and accordingly other characteristics have been of importance in dividing these subspecies.

About the latest found subspecies *roensis* (HINTON 1920) POHLE remarks: 'Die Masse der Schädel liegen vollkommen innerhalb der Variationsbreite der Schädelmasse von *Lutra lutra* wie es ja auch nach den Befunden bei den anderen Unterarten zu erwarten war'. This again underlines the result of this investigation concerning the skull of the Norwegian otter: that this animal apart from age-variation and sexdimorphism has a great capability of individual variation in this respect, and accordingly slightly different trends in skull-building do not in my opinion justify the introduction of new subspecies.

VII. SUMMARY

The present work is a craniometric investigation of the recent Norwegian otter *Lutra lutra* (L.) based upon 54 skulls, the geographical distribution of 52 is given on fig. 1, further information on page 12 and the measuring results of 35 different skull-measures in the tables 1 and 2.

The work concerns also the subfossil remnants of otter-crania found in Norwegian stone-age dwellings, the distribution of which is given on fig. 1, further informations on page 14 and the measuring results in the tables 3 and 4.

The table-numbers have been treated statistically and have given the following results:

1. As to skull-length *my material* does not indicate the existence of a difference between otters from salt and fresh water.

2. I have not found the age determining method in seals, introduced by Scheffer (1950) and Laws (1952), reliable neither by the otter nor by the badger.

3. Based upon the measuring tables of Hooper and Ostenson (1949) I have found that the skull of *Lutra canadensis* (Schreb.) changes with age even after the animals are fully grown-up.

4. Based upon the measuring tables of Pohle (1919) I have found that the dimensions of the remaining teeth of *Lutra lutra* (L.) do not change with age in a similar way as do the dimensions of the skull.

5. Considered as groups, the skulls of Norwegian male and female otters seem to differ from each other as the skulls and teeth of the males are heavier built than those of the females. Concerning the length and height of the calvary this difference seems to be conform, but as to breadth around the orbit the female otters are relatively broader than are the males.

6. There does not seem to exist any differences between the skull- and teeth-dimensions of recent otters from Norway and Denmark (represented by the material of Degerbøl 1933).

7. Neither does there exist such differences between recent otters from Norway and other Western European countries represented by the material of Miller (1912).

8. However, comparisons between the material of Pohle (1919) and others show that slightly different trends as to skull-building *may* be present in the *Lutra lutra*, but because of the deficiencies of materials, further research is

necessary to decide the importance of the observed differences which in my opinion do not justify the introduction of new subspecies.

9. There seems to exist no difference between the subfossil otters from Norway and Denmark (represented by the material of Degerbøl 1933).

10. It seems that a decrease in greatness — the general tendency of evolution shown by many Scandinavian mammals during the last 3 000—4 000 years — to a certain extent also has been followed by the otter.

VIII. REFERENCES

Allen, G. M.: The mammals of China and Mongolia. *Natural history of central Asia.* Vol. 11, part 1. N. Y. 1938.

Brinkmann, A.: Canidenstudien I—III. *Vidensk. Medd. dansk naturh. foren.* Kbh. Vol. 72. Kbh. 1920.

Bræstrup, F. W.: Rovdyr. In: Vort lands dyreliv. Kbh. 1949.

Collett, R.: Norges pattedyr. Chria. 1911.

Degerbøl, M.: Danmarks pattedyr i fortiden i sammenligning med recente former. *Vidensk. Medd. dansk naturh. foren. Kbh.* Vol. 96. Kbh. 1933.

— Fangstboplassen i Vistehulen på Viste, Randaberg, Nord-Jæren. Stvg. 1951.

Duerst, J. U.: Vergleichende Untersuchungsmethoden am Skelett bei Säugern. Abderhalden: *Handbuch der biologischen Arbeitsmethoden.* Abt. VII. Halle 1926.

Gjessing, G.: Norges stenalder. Oslo 1945.

Hinton, M. A. C.: The Irish Otter. *Ann. Mag. nat. Hist.* (9) No. 30. Lond. 1920.

Hooper, E. T. & Ostenson, B. T.: Age Groups in Michigan Otter. *Occ. Pap. Mus. Zool. Univ. Mich.* No. 518. Ann Arbor 1949.

Hysing-Dahl, C.: Den norske grevling, *Meles meles* (L.) *Univ. i Bergen Årb. naturv. r.* 1954. Nr. 16. Bergen 1954.

Ingebrigtsen, O.: Das norwegische Rotwild. *Bergens Mus. Aarb.* 1922—23. Nr. 7. Bergen 1924.

Johnsen, S.: Rovdyrene. (In:) Norges dyreliv. Vol. I. Oslo 1947.

Latimer, H. B.: Weights and linear dimensions of the skull and some of the long bones of the skunk. (*Mephitis mesomelas avia*). *J. Morph.* No. 60. Philad. 1937.

— & Riley, R. B.: Measurements of the skull and some of the long bones of the muskrat. (*Ondatra zibethicus cinnamominus*). *J. Morph.* No. 56. Philad. 1934.

Laws, R. M.: A new method of age determination for mammals. *Nature, Lond.* Vol. 167. Lond. 1952.

Lönnberg, E.: Sveriges jaktbara djur. (In:) Svenska jordbrukets bok. Sth. 1923.

Melchior, H. E.: Den danske stats og Norges pattedyr. Kbh. 1834.

Miller, G. S.: Catalogue of the mammals of western Europe (Europe exclusive of Russia) in the collection of the British Museum. *Trustees Brit. Mus.* Lond. 1912.

Olstad, O.: Trekk av Sydishavets dyreliv. *Norsk geogr. Tidsskr.* 2. Oslo 1929.

— Jaktzoologi. Oslo 1945.

Pocock, R. I.: On the external characters of some species of Lutrine (Otters). *Proc. zool. Soc. Lond.* Lond. 1921.

Pohle, H.: Die Unterfamilie der Lutrinae. *Arch. Naturgesch.* 85. Berl. 1919.

Schäff, E.: Über die Grösse des Schädels ausgewachsener Fishotter *S. B. Ges. naturf. Fr. Berl.* No. 5. Berl. 1889.

Scheffer, V. B.: Growth layers in the teeth of Pinnipedia as an indication of age. *Science.* vol. 112. No. 2907. N. Y. 1950.

Sivertsen, E.: A survey of the eared seals (family *Otaridae*) with remarks on the antarctic seals collected by M/K «Norvegia» in 1928—1929. *Avh. norske Vidensk.Akad.* No. 36. Oslo 1954.

Thomas, O.: Preliminary notes on the characters and synonymy of the different species of otter. *Proc. zool. Soc. Lond.* 1889. Lond. 1889.

Wagner, K.: Rezente Hundrassen, eine osteologische Untersuchung. *Skr. norske Vidensk. Akad. Oslo.* I. Matem.-naturvid. Klasse. No. 9. Oslo. 1929

Printed March 1959.

IX. TABLES

Key to the tables 5, 6 and 7 (Discriptive parameters).
Group 1. Norwegian females.
» 2. » males
» 3. All Norwegian recent
» 4. All Danish recent (Degerbøl)
» 5. Recent otters from Western Europe (Miller)
» 6. Norwegian subfossils
» 7. Danish subfossils (Degerbøl)
» 8. Recent *Lutra lutra lutra,* the sample of Pohle

Table 1. Recent Otters

Number	Sex	Age	Country	County	County district	Profile-length 7	Condylobasal-length 8	Basilar-length 9	Length of inner braincase 10	Basion — middle of frontal 11	Middle of frontal — prosthion 12	Length of rostrum 13	Palatal length 14	Zygomatic Breadth 17	Mastoid breadth 18	Breadth of brain-case 19	Breadth between Processi postorbitales 20	Postorbital constriction 21	Interorbital constriction 22	Breadth of rostrum over canines 25	Palatal depth 26	Occipital depth 27
323	1	1	1	3	10																	
326	1	5	1	3	26	101,7	106,4	97,5	63,–	69,3	39,9	28,8	46,7	67,7	61,4	51,7	20,4	14,8	18,3	25,6	21,4	32,9
324	1	3	1	9	6	110,4					43,3	30,1	51,2	70,9	67,4	56,0	21,2	16,0	20,2	25,8	21,7	
288	1	4	1	13	4	107,7	109,1	101,4	65,–	72,5	41,4	29,0	48,7	66,6	62,0	52,4	22,2	13,7	19,4	25,1	22,3	32,8
286	1	5	1	13	4	108,7	110,0	101,8	65,–	73,5	42,4	30,9	50,0	68,7	61,5	51,4	21,9	14,1	19,9	26,6	22,8	33,6
290	1	5	1	13	43	109,5	109,5	102,3	67,–	74,4	41,8	30,3	49,0	68,8	61,6	*52,4	21,5	12,8	19,6	26,6	23,2	34,1
291	1	5	1	13	43	104,6	106,7	98,9	64,–	71,9	39,8	28,4	48,0	71,1	63,4	53,4	23,0	15,4	20,4	25,5	22,2	35,5
292	1	5	1	13	43	109,3	111,4	103,3	68,–	73,8	42,5	30,6	49,5	69,5	61,8	51,3	21,0	13,0	19,3	25,9	22,4	32,1
293	1	5	1	13	43	108,9	109,3	101,2	67,–	73,2	42,2	30,0	47,6	67,2	60,9	50,8	22,6	11,8	19,0	25,9	22,7	32,3
294	1	3	1	13	43	110,4	113,4	104,3	69,–	75,6	42,1	30,8	50,1	*69,8	64,2	54,4	24,1	17,9	22,5	27,3	22,9	32,5
299	1	3	1	13	22	110,0					43,2	30,8	50,3	67,1		55,5	21,6	15,5	20,8	27,8	23,6	
301	1	4	1	13	22	105,7	112,1	102,3	68,–	76,1	39,4		48,7	67,9	63,7	53,8	22,2	15,4	20,4	26,3	23,3	33,6
302	1	5	1	13	22	105,9	109,5	101,2	66,–	74,1	41,0	29,3	48,3	66,5	60,9	51,0	25,6	15,8	20,7	25,4	22,4	32,0
303	1	2	1	13	22																	
304	1	6	1	13	22	105,8	107,8	100,0	65,–	72,2	41,6	29,4	48,3	67,2	63,2	52,4	25,4	14,3	20,7	25,9	22,5	34,9
281	1	5	1	14	29	106,6	108,2	99,5	64,–	71,9	41,2	29,0	46,3	71,3	65,5	54,4	24,8	14,2	20,2	27,0	23,6	34,4
282	1	5	1	14	29	103,0	106,3	98,5	65,–	70,7	40,4	29,0	46,6	67,2	62,1	51,9	23,7	16,2	20,9	25,7	21,8	32,3
283	1	5	1	14	29	110,1		*101,4	64,–	*73,5	42,5	30,2	49,8	69,7	65,6	55,2	24,0	13,7	19,9	27,9	23,4	36,0
276	1	5	1	17	3	104,3	109,1	100,8	66,–	72,7	39,6	28,6	47,2	67,5	59,1	51,0	23,6	16,7	20,7	25,8	22,7	33,4
277	1	5	1	17	3	106,9	109,1	101,1	67,–	72,7	40,4	28,8	47,5	70,0	60,4	51,0	22,4	15,6	19,8	26,5	22,5	32,4
278	1	4	1	17	3	112,6	114,8	105,6	69,–	75,0	41,7	30,1	50,4	68,5	62,0	53,0	23,1	16,6	20,3	25,8	22,5	32,8
279	1	4	1	17	3	112,8	114,1	105,2	69,–	75,8	42,7	30,2	50,6	67,6	61,2	51,9	22,5	17,0	21,2	26,1	22,8	35,2
274	1	1	1	17	3																	

325	2	5	1	9	6	111,4	115,0	107,7	69,–	78,3	42,6	30,5	50,8	73,3	66,6	55,1	28,0	15,1	22,7	28,3	24,7	36,8
306	2	5	1	10	2	115,8	118,8	111,0	70,–	79,4	43,7	32,6	53,5	78,0	70,1	58,7	24,0	13,4	22,3	29,8	24,5	36,5
308	2	4	1	10	2	108,5	113,5	105,4	68,–	75,3	42,8	31,4	49,9	70,6	64,1	54,4	21,0	13,5	21,4	27,0	23,0	35,3
307	2	5	1	10	8	102,6	107,0	99,3	65,–	70,1	40,3	29,1	45,5	66,0	59,0	50,6	19,0	13,5	18,2	24,3	21,5	32,5
289	2	5	1	13	4	105,0	107,8	99,9	64,–	71,8	41,1	29,4	49,3	67,8	61,9	51,3	20,4	13,6	19,5	26,3	24,5	34,0
285	2	5	1	13	40	116,1	119,2	110,5	70,–	80,2	44,6	32,5	53,8		69,1	57,2	25,2	12,0	22,1	30,0	24,3	34,8
295	2	5	1	13	22	108,5	112,2	104,2	67,–	75,2	42,2	30,1	50,4	70,4	63,9	54,5	23,0	13,7	19,9	27,8	23,1	34,0
296	2	3	1	13	22	113,5	115,4	106,7	68,–	77,5	45,6	31,5	51,4	68,4	64,7	56,1	23,9	17,8	21,3	27,8	25,3	34,8
297	2	5	1	13	22	114,6	116,8	108,0	70,–	78,2	44,6	32,3	52,2	72,3	65,9	54,8	25,7	14,0	22,3	28,1	24,1	37,3
300	2	5	1	13	22	108,8	109,6	101,0	65,–	72,6	42,0	29,7	48,6	70,0	64,8	54,4	22,9	15,1	20,3	27,0	22,5	33,1
284	2	5	1	14	8	113,4	113,5	104,7	68,–	76,7	42,3	30,3	49,8	74,4	67,5	55,5	22,6	15,6	20,3	29,0	24,7	36,6
273	2	5	1	17	3	119,5	119,7	111,0	71,–	81,9	43,8	31,9	53,9	80,1	69,3	59,6	26,3	16,2	23,0	30,3	24,9	39,3
275	2	5	1	17	3	119,1	121,7	113,0	74,–	82,8	44,9	32,6	53,1	77,6	71,1	59,5	27,5	15,7	23,5	29,0	24,5	38,6
287	2	5	1			118,2	115,1	107,7	71,–	79,4	44,9	31,9	52,3	75,0	67,4	57,2	22,7	14,0	21,3	28,7	24,1	38,2
332		5	1	3	6	107,0	110,6	102,5	67,–	74,4	42,6	30,1	48,4	70,4	64,1	53,7	20,9	13,7	18,8	27,8	22,9	34,6
331		2	1	3	13																	
328		1	1	6	18																	
309		5	1	10		104,3	105,2	98,4	63,–	70,0	39,9	28,7	46,3	67,7	60,2	51,8	23,5	13,4	20,5	25,2	21,8	31,2
298		1	1	13	22																	
271		4	1	12		*118,0	122,8	114,5	74,–	82,8	46,2	31,8	54,7	75,0	69,1	59,8	29,0	18,9	24,7	28,5	25,8	*34,3
280		4	1	12		98,5	103,0	96,4	62,–	68,7	37,9	*27,0	46,0	64,8	59,4	49,0	21,0	11,7	17,8	23,7	20,3	30,9
333		3	1	13	44	107,7	110,0	102,4	65,–	72,6	41,9	29,7	49,5	66,8	63,0	52,8	20,0	14,9	19,2	25,6	22,6	33,4
313		5	1	18	28	110,0	112,3	105,6	70,–	76,6	41,9	29,5	48,7	72,1	61,8	53,5	23,4	14,7	21,5	27,8	23,0	32,0
314		5	1	18	28	101,9					38,7	27,6	46,1	66,5	60,6	51,1	20,5	13,4	19,1	26,2	21,6	
315		4	1	18	28	104,7	106,0	98,0	62,–	69,2	40,7	28,9	46,9	67,3	62,1	53,3	21,2	14,6	18,2	25,4	22,6	32,1
317		5	1	19		117,7	120,9	112,3	73,–	82,3	45,6	32,5	53,5	80,9	71,3	59,7	24,8	15,5	23,3	30,6	24,7	37,5
316		5	1	19	8	117,2	120,6	111,9	71,–	80,3	47,0	34,1	56,5		68,0		27,6	15,7	23,3	29,3	25,5	37,0
318		5	1	19	8	119,0	122,0	112,6	72,–	81,4	45,8	33,0	56,1	79,2	70,7	59,1	25,2	15,3	22,9	31,6	25,7	38,2
330		2	1	19	9	116,4	118,3	109,6	70,–	78,2	47,0		48,8	70,8	66,5	56,2	25,2	19,0	22,5	28,4	23,6	35,7
327		5	1	19	11	105,1	106,7	100,4	67,–	72,6	40,8	29,0	47,3	70,4	61,0	52,8	23,4	15,4	20,6	26,7	23,0	33,5
321		5	1			111,4	114,1	107,1	70,–	77,1	41,4	30,2	51,3		63,7	55,2	22,1	13,0	20,6	28,3	22,8	35,5

Table 2. Recent Otters

Number	Sex	Age	Country	County	County district	Maxillary tooth-row	P.4. Length	P.4. Breadth	Length of talon P.4.	M.1. Greatest diameter	M.1. Greatest length	Mandible total length	Gonion ventrale — Coronion	Depth of mandible between P.4. and M.1.	Greatest thickness	Mandibular tooth-row	Length of premolars	Length of Molars	M.2. Greatest diameter	P.4. Length	P.4. Breadth	M.1. Length	M.1. Breadth
						34	35	36	37	38	39	40	42	43	46	48	49	50	51	54	55	56	57
323	1	1	1	3	10		10,7	7,6	6,6	11,0	6,9						16,7	16,5	5,3			12,0	6,1
326	1	5	1	3	26	29,1	11,1	8,0	7,2	11,0	7,5	66,5	32,0	10,0	6,2	33,4	16,7	17,4	6,0	7,7	4,5	13,2	6,7
324	1	3	1	9	6	30,0	10,9	8,0	7,2	11,0	7,1												
288	1	4	1	13	4	30,3	10,7	7,9	7,1	11,6	7,3	69,0	31,7	10,8	6,4	33,9	16,7	17,5	5,1	7,7	4,3	12,9	*6,3
286	1	5	1	13	4	31,3	11,6	8,1	7,6	11,8	7,4	67,8	33,2	10,7	6,8	34,9	16,9	18,0	5,4	8,5	4,5	13,9	6,5
290	1	5	1	13	43	30,2	11,0	8,2	7,4	12,3	7,7	70,9	33,6	11,8	6,8	34,5	16,9	18,2	5,7	7,7	4,3	13,3	6,6
291	1	5	1	13	43	28,5	10,9	7,9	7,0	11,7	*7,4	68,1	33,1	11,2	6,8	33,4	16,5	17,2	5,4	8,0	4,5	13,0	6,3
292	1	5	1	13	43	29,7	10,9	8,1	7,3	12,1	7,4	68,8	31,1	11,1	6,4	34,3	16,8	17,2	5,5	7,4	4,1	13,0	6,4
293	1	5	1	13	43	29,1	10,7	7,9	7,3	11,2	7,3	69,6	32,7	11,0	6,8	33,4	16,3	17,2	5,5	7,2	4,2	12,7	6,4
294	1	3	1	13	43	30,2	10,8	8,0	6,8	11,4	7,6	70,5	32,1	11,2	6,7	33,9	17,0	17,5	5,6	8,2	4,4	13,3	6,5
299	1	3	1	13	22	31,5	11,8	8,7	7,8	12,1	7,9	71,3	33,2	10,6	7,6	34,8	17,8	18,2	6,2	8,3	4,6	14,1	7,3
301	1	4	1	13	22	30,4	11,1	8,1	7,3	11,8	7,6	70,6	34,9	11,2	7,1	33,3	17,0	17,7	5,7	7,7	4,2	13,4	6,6
302	1	5	1	13	22	29,4	*10,3	7,6	6,9	11,2	7,0	68,4	34,2	10,7	7,1	*32,0	*16,0	*15,6	5,3	*7,3		12,1	6,4
303	1	2	1	13	22	29,8	10,5	7,9	6,8	11,3	7,3					32,8	16,3	17,4	5,6	7,6	4,0	12,8	6,3
304	1	6	1	13	22	28,3	10,4	7,7	6,8	11,0	6,9	68,1	33,9	10,9	6,9	31,4	15,5	16,0	4,9	6,7	3,9	12,2	5,7
281	1	5	1	14	29	29,6	11,3	8,4	7,5	11,7	7,6	69,4	33,4	12,1	6,6	34,6	17,0	18,2	5,5	8,2	4,4	13,6	6,6
282	1	5	1	14	29	*28,0	10,7	7,8	7,0	10,8	6,9	67,1	32,6	10,7	6,6	32,5	*16,2	17,1	4,9	*7,3	4,3	12,8	6,1
283	1	5	1	14	29	30,5	11,3	8,3	7,6	11,5	7,3	71,1	34,2	12,6	6,8	34,8	16,5	17,9	5,2	8,2	4,4	13,4	6,5
276	1	5	1	17	3	28,6	10,9	8,2	7,0	11,1	6,9	68,1	33,1	11,8	6,9	32,8	16,7	16,5	4,9	*7,4		12,6	6,3
277	1	5	1	17	3	28,2	10,8	8,2	7,2	11,0	6,9	68,7	34,3	11,5	7,4	32,5	16,5	16,8	5,0	7,5	4,1	12,8	6,1
278	1	4	1	17	3	30,0	11,2	8,0	7,5	11,2	6,9	71,8	35,8	11,1	6,3	33,6	17,3	16,5	5,1	7,8	4,3	12,4	6,2
279	1	4	1	17	3	30,3	11,2	8,0	7,3	11,3	7,2	71,1	35,2	11,1	6,6	33,8	17,4	17,2	5,3	8,1	4,4	12,6	6,4
274	1	1	1	17	3		11,3	8,7	7,8	11,6	7,2						17,0	18,4	5,7	8,1	4,7	13,5	7,0

325	2	5	1	9	6	30,2	11,1	8,4	7,8	11,6													
306	2	5	1	10	2	31,5	11,5	9,1	8,5	12,2	7,6	78,7	38,1	11,6	8,0	35,6	18,1	18,1	5,5	8,0	4,7	13,6	7,3
308	2	4	1	10	2	31,4	11,5	8,5	7,7	11,8	7,4	74,1	35,5	11,5	7,5	35,4	17,6	18,0	5,5	8,1	4,4	13,1	6,5
307	2	5	1	10	8	28,7	10,8	8,4	7,1	11,8	7,4	67,6	31,3	10,1	6,6	32,7	16,5	16,7	5,5	7,4	4,1	12,8	6,6
289	2	5	1	13	4	30,2	10,9	8,1	7,6	12,0	7,3	68,0	32,3	10,9	7,5	34,4	17,2	17,2	5,8	7,7	4,3	13,0	6,7
285	2	5	1	13	40	31,9	*11,5	8,9	7,6	*12,4	7,9	76,8	36,9	13,0	8,5	36,6	*18,0		*5,6	*8,5	4,8	*14,0	*7,0
295	2	5	1	13	22	30,5	11,0	8,2	7,4	11,8	7,7	72,3	34,6	11,4	7,1	34,1	17,4	17,8	5,9	8,0	3,9	13,0	6,8
296	2	3	1	13	22	30,6	11,2	8,4	7,6	12,2	7,9	72,3	36,5	11,3	7,3	35,0	17,5	18,3	6,2	*7,4	4,4	13,4	6,9
297	2	5	1	13	22	*32,3	*11,3		8,1	*12,9	7,9	*77,2	35,8	12,3	7,6	*35,4	*17,5	*18,7	6,0	*7,6		*14,1	*7,0
300	2	5	1	13	22	29,9	*10,5	8,2	*7,3	11,7	*7,4	70,8	34,2	12,2	7,7	*33,2	*16,3	*17,4	5,7			*13,0	6,6
284	2	5	1	14	8	31,6	11,7	8,8	8,0	12,3	8,0	70,5	34,2	12,3	7,7	35,4	*17,4	19,1	6,3	*8,4	4,8	*14,0	*7,0
273	2	5	1	17	3	31,8	12,0	9,2	8,1	12,8	7,6	77,3	40,4	13,7	8,6	35,8	17,5	18,7	5,7	8,5	4,9	14,5	7,0
275	2	5	1	17	3	31,2	11,7	8,8	7,7	12,5	7,9	77,7	38,5	13,9	8,0	35,7	17,6	18,9	5,8	8,3	4,5	14,2	7,1
287	2	5	1			30,8	11,5	9,1	7,9	12,2	7,7	76,0	37,7	12,3	7,5	35,4	17,7	19,2	6,1	*7,6	4,6	14,3	6,7
332		5	1	3	6	29,7	11,2	8,2	7,4	11,6	7,6	68,8	32,9	11,2	7,1	33,8	16,0	17,2	5,7	7,2	4,1	12,7	6,6
331		2	1	3	13		11,9	9,3	8,2	12,8	7,9								5,3			14,0	7,4
328		1	1	6	18		10,0	7,7	6,8	11,3	6,8								5,0	7,2	3,8	12,1	5,9
309		5	1	10		28,5	10,8	7,8	7,1	11,2	7,0	68,1	33,4	10,0	6,8	32,3	15,6	17,0	5,6	7,1	3,9	12,0	6,2
298		1	1	13	22		11,2	8,1	7,2	11,5	7,2								5,5	7,6	4,2	13,0	6,7
271		4	1	12		*33,1	12,3	9,2	8,0	12,9	7,4	77,7	39,0	12,4	7,3	37,5	18,9	18,9	5,6	9,0	4,8	14,5	7,1
280		4	1	12		28,1	10,3	7,6	6,7	11,0	6,8	64,4	31,0	9,4	5,7	31,6	16,0	16,4	4,9	7,6	4,0	12,7	6,1
333		3	1	13	44	31,3	10,9	8,4	7,5	11,8	7,3												
313		5	1	18	28	30,0	11,8	8,6	7,5	11,8	7,3	70,5	33,9	12,1	7,4	34,3	17,5	17,2	5,6	8,3	4,4	13,4	6,5
314		5	1	18	28	28,2	11,2	8,3	7,2	11,5	6,9	68,2	32,4	10,4	6,6	32,4	16,0	16,7	4,9	*8,2	4,7	13,0	6,3
315		4	1	18	28	30,0	11,5	8,4	7,6	12,0	7,6	67,3	32,4	10,3	7,0	33,9	17,0	17,9		7,8	4,6	13,5	6,9
317		5	1	19		33,2	12,5	9,8	8,8	12,8	7,9	78,7	40,3	12,3	8,4	37,0	19,6	18,4	5,8	9,4	5,5	14,2	7,4
316		5	1	19	8	33,0	12,2	9,4	*8,5	13,1	7,9	77,7	36,9	12,6	7,7	37,0	19,2	18,9	5,8	9,2	4,9	14,4	7,0
318		5	1	19	8	32,7	12,5	10,0	8,4	13,7	7,9	76,5	37,6	12,2	8,5	37,1	19,1	19,1	6,3	9,4	5,3	14,5	7,4
330		2	1	19	9	*32,6	12,3	9,4	8,4	13,4	7,9												
327		5	1	19	11	30,4	*11,0	*8,6	7,7	*12,2	7,3												
321		5	1			31,7	12,0	9,0	8,2	12,4	7,7												

Table 3. Subfossil Otters

Catalogue number of finding-place	County	County district	P.4. Length	P.4. Breadth	Length of talon P.4.	M.1. Greatest diameter	M.1. Greatest length	Mandible total length	Gonion ventrale — coronion	Depth of Mandible between P.4. and M.1.	Greatest thickness	Mandibular tooth-row	Length of premolars	Length of Molars	M.2. Greatest diameter	P.4. Length	P.4. Breadth	M.1. Length	M.1. Breadth
			35	36	37	38	39	40	42	43	46	48	49	50	51	54	55	56	57
216	11	17																	
112	11	16							34,6	10,8	6,8							*12,5	
112	11	16									7,4					8,5	4,5	*13,8	
112	11	16																*13,2	
112	11	16								11,7	6,6	*35,4	18,3			7,9	4,3	*12,9	
112	11	16																*13,1	
112	11	16						69,4	35,5	11,3	6,9		16,7	17,4		7,6	3,9	12,6	6,0
112	11	16								12,0	7,5		18,6	18,9				13,8	6,9
112	11	16							35,5	10,7	6,8			17,5				12,7	6,0
112	11	16									8,1							14,0	6,9
112	11	16								10,5	6,7	33,9	17,2	16,6	4,9	7,9	4,3	12,8	6,5
112	11	16							33,3										
112	11	16											17,5			7,7	4,0		
112	11	16									7,7							*13,3	
112	11	16									6,3							*12,4	
112	11	16									6,9		16,6					*12,8	

112	11	16									*7,9							*13,6	
112	11	16								12,0	7,0					8,4	4,4	*13,0	
257	13	10														7,9	4,5	13,7	6,8
199	13	10																	
148	13	32																	
1	13	33				13,8	8,2												
1	13	33	11,6	8,0	7,0	12,0	7,5												
1	13	33	11,1	7,9	7,5														
1	13	33				12,0	7,3												
1	13	33	11,8	9,1	8,0	12,7	8,0												
1	13	33	11,4	8,3	7,5	12,0	7,5												
1	13	33						*65,0		10,0	8,1	*35,0						14,5	7,0
1	13	33						*65,0		11,4	6,5	34,6	17,5	16,5	5,2	8,0	4,4	12,1	6,4
1	13	33																13,2	6,5
1	13	33								9,5	7,1							*12,6	
1	13	33							28,9		6,5								
1	13	33									6,9							*13,8	
1	13	33	11,6	8,5	8,0														
1	13	33				11,8	7,3												
1	13	33								*10,5	6,4				5,6			*13,3	
1	13	33							28,0		7,2							13,3	6,8
1	13	33								10,8	6,5		17,0	17,6	6,2	7,9	4,7	13,2	6,8
1	13	33								12,1	6,5		17,5			7,8	4,3	*12,7	6,4
258	13	35																14,4	7,0
258	13	35								13,5	8,0					8,0	4,6	*12,9	
258	13	35																13,0	
258	13	35								11,2	6,9	*34,1	17,3	17,0		7,4	4,3	13,0	6,5

Table 4. Subfossil Otters

Catalogue number of finding-place	County	County district	Maxillary tooth-row	P.4. Length	P.4. Breadth	Length of talon P.4.	M.1. Greatest diameter	M.1. Greatest length	Mandible total length	Gonion ventrale — Coronion	Depth of Mandible between P.4. and M.1.	Greatest thickness	Mandibular tooth-row	Length of premolars	Length of molars	M.2. Greatest diameter	P.4. Length	P.4. Breadth	M.1. Length	M.1. Breadth
			34	35	36	37	38	39	40	42	43	46	48	49	50	51	54	55	56	57
258	13	35									11,9	7,3							*13,4	
258	13	35									11,1	7,0								
258	13	35															7,8	4,2	*12,7	
258	13	35								31,3										
258	13	35												18,3			8,4	5,1		
258	13	35																	*13,3	
258	13	35																	*12,2	
258	13	35																	*12,9	
258	13	35								37,4		*7,4								
258	13	35																	*13,0	
258	13	35									10,8	7,1							*13,3	
258	13	35							71,8		11,4	7,8	34,4	17,0	16,9		7,2	4,4	12,8	6,3
258	13	35									12,2	7,3							*13,8	
258	13	35																	*13,0	
258	13	35									13,0	7,5							*13,6	
258	13	35							77,2	38,8	13,0	7,2	37,7	17,8	18,7		8,5	4,3	14,3	7,1
258	13	35									10,2	7,0							12,8	6,4
258	13	35									12,5	6,6							*14,1	
258	13	35								38,4	13,7	7,0		17,2	18,0		8,6	4,6	14,0	7,0
258	13	35								33,9	11,4	6,5	*35,2	17,3			7,9	4,5	*13,4	
258	13	35									10,8	6,5	*33,0	16,0	17,2		7,9	4,4	13,2	6,4
258	13	35							74,0		12,6	7,6		18,9	18,7		8,2	4,5	14,5	7,2
258	13	35		11,8	8,6	8,0	12,5	7,9												
258	13	35		11,0	7,9	6,9	11,7	7,8												

258	13	35		*11,6	8,5	7,8	12,1	8,1												
258	13	35	33,4	12,0	9,0	8,5	12,7	7,9												
258	13	35		11,2	7,9	7,4	10,8	7,7												
258	13	35		12,1			12,3	7,7												
258	13	35		11,4	8,5	8,0														
258	13	35					11,9	7,5												
258	13	35	32,7	11,7	9,2	8,9	12,7	8,1												
258	13	35		*10,5	8,6	8,4														
6	15	40									*11,9	7,8	*35,8		18,5				14,1	7,2
16	15	52					11,9	7,4												
153	15	52		11,7	8,8	8,3														
193	15	55										6,4							*13,8	
5	15	19									14,0	7,7	*37,0	18,2	18,4		8,3	4,8	13,8	6,8
5	15	19							*73,6		13,6	8,0	*36,7	17,9	18,7		8,3	5,0	14,6	
9	15	8									13,3	8,1	*36,3	18,3	18,2	5,6	8,7	4,6	14,6	*6,6
111	16	13																		
10	16	38																		
8	16	42																	*13,7	
14	17	15							70,7		12,2	7,5							13,7	7,3
14	17	15									14,0	8,4							*14,0	7,4
14	17	15									12,9	7,9							*12,7	
14	17	15																	*14,2	
260	17	25										9,2				5,7			15,0	7,4
260	17	25									15,7	8,9							*14,4	
260	17	25									14,7	10,2				6,7	9,1	5,7	*14,2	7,6
260	17	25									13,6	11,0	37,8	18,7			8,6	5,2	*14,6	
260	17	25								35,3		7,8				5,5	8,2	4,7	13,4	6,7
260	17	25								33,6	11,9	7,6	35,3	17,6	17,5	5,6	7,9	4,5	13,2	6,7
260	17	25									14,0	9,2					9,3	5,7	14,8	7,6
260	17	25																	*12,9	
260	17	25		12,9	9,7	9,6	*12,8	8,4												
260	17	25		12,3	9,7	9,0	12,8	8,4												
260	17	25	29,8	11,6	8,5	7,3	12,4	7,8												
349	19	17																		

Table 5.

Group no.	Measurement no.	Total number of individuals	Mean value	Variance	Group no.	Measurement no.	Total number of individuals	Mean value	Variance
1	07	20	107,745	8,7905	1	18	19	62,521	3,9607
2	07	14	112,500	25,4486	2	18	14	66,100	10,3371
3	07	48	109,767	27,3481	3	18	47	64,145	11,3492
4	07				4	18	16	63,194	11,5185
5	07				5	18	19	63,684	15,8253
1	08	17	109,812	6,2223	8	18	43	64,161	16,0630
2	08	14	114,664	18,4779	1	19	20	52,745	2,5495
3	08	44	112,377	26,1729	2	19	14	55,636	6,7450
4	08	16	113,981	33,1575	3	19	47	54,081	7,5382
5	08	19	114,305	36,7095	4	19	16	53,100	4,9513
1	09	18	101,461	4,5548	8	19	43	54,074	8,1640
2	09	14	106,436	17,0590	1	20	20	22,840	1,9894
3	09	45	104,180	22,6798	2	20	14	23,729	6,3947
4	09	16	105,556	27,5814	3	20	48	23,267	4,8328
8	09	42	106,009	31,3350	4	20	16	21,750	5,0950
1	10	18	66,167	3,4502	8	20	44	22,168	4,9222
2	10	14	68,572	6,9200	1	21	20	15,025	2,3149
3	10	45	67,489	9,3090	2	21	14	14,514	2,0439
4	10				3	21	48	14,852	2,7362
5	10				4	21	16	14,181	3,8276
1	11	18	73,272	2,9994	5	21	16	13,750	2,0125
2	11	14	77,100	13,0629	8	21	42	14,241	2,0984
3	11	45	75,211	14,6893	1	22	20	20,210	0,7589
4	11				2	22	14	21,293	2,0791
5	11				3	22	48	20,735	2,4122
1	12	20	41,455	1,3785	4	22	16	20,094	2,2218
2	12	14	43,243	2,3248	5	22	21	19,971	2,1849
3	12	48	42,331	4,4590	8	22	44	19,907	1,8868
4	12				1	25	20	26,225	0,5709
5	12				2	25	14	28,100	2,4029
1	13	19	29,700	0,6411	3	25	48	27,146	2,8905
2	13	14	31,129	1,4344	4	25			
3	13	46	30,265	2,2480	5	25	22	26,773	2,2701
4	13				1	26	20	22,635	0,3453
5	13				2	26	14	23,979	1,0357
1	14	20	48,740	2,0374	3	26	48	23,215	1,4716
2	14	14	51,036	5,1377	4	26			
3	14	48	49,779	7,1029	5	26	22	24,473	3,4826
4	14	16	50,475	9,2331	1	27	18	33,489	1,4928
8	14	44	51,555	9,0710	2	27	14	35,843	4,0745
1	17	20	68,540	2,2144	3	27	45	34,456	4,3649
2	17	13	72,608	16,8876	4	27			
3	17	45	70,369	15,2134	5	27	17	35,582	3,9822
4	17	16	69,269	18,8598					
5	17	19	70,221	17,0980					
8	17	39	70,167	18,8920					

Table 6.

Group no.	Measurement no.	Total number of individuals	Mean value	Variance	Group no.	Measurement no.	Total number of individuals	Mean value	Variance
1	34	21	29,667	0,8895	1	42	19	33,384	1,4199
2	34	14	30,900	0,8600	2	42	13	35,846	6,0188
3	34	49	30,369	1,9453	3	42	42	34,526	5,8795
4	34	16	31,269	2,0681	4	42			
8	34	44	31,366	2,1500	5	42			
6	34	03	31,967	2,4182	6	42	13	34,192	10,0097
1	35	23	10,961	0,1253	7	42			
2	35	14	11,300	0,1543	1	43	19	11,163	0,3399
3	35	54	11,220	0,3269	2	43	13	12,038	1,0725
4	35	16	11,369	0,3143	3	43	42	11,464	0,9336
5	35	21	11,076	0,3506	4	43	15	11,080	1,2296
6	35	18	11,628	0,2605	8	43	39	11,585	0,8822
1	36	23	8,057	0,0743	6	43	40	12,110	1,9134
2	36	13	8,623	0,1332	7	43	21	11,810	1,5486
3	36	53	8,400	0,3192	1	46	19	6,779	0,1181
4	36	15	8,587	0,0836	2	46	13	7,662	0,2634
5	36	21	8,333	0,2745	3	46	42	7,164	0,4319
6	36	17	8,629	0,3080	4	46	14	7,114	0,5247
8	36	45	8,347	0,2384	5	46			
1	37	23	7,217	0,1051	6	46	53	7,447	0,8758
2	37	14	7,743	0,1213	7	46	23	7,265	0,4247
3	37	54	7,511	0,2563	1	48	20	33,530	0,9151
4	37	16	8,300	0,2275	2	48	13	34,977	1,1037
5	37				3	48	43	34,237	2,2933
6	37	17	8.006	0,4973	4	48	15	35,387	2,6467
1	38	23	11,422	0,1605	8	48	37	35,319	3,0304
2	38	14	12,157	0,1513	6	48	15	35,480	1,8483
3	38	54	11,850	0,4425	7	48	05	35,240	0,0984
4	38	16	11,825	0,3769	1	49	22	16,714	0,2269
5	38	21	11,505	0,4530	2	49	13	17,408	0,2338
6	38	18	12,272	0,3781	3	49	45	17,087	0,8097
8	38	44	11,766	0,4075	4	49	14	18,293	0,8266
1	39	23	7,270	0,0816	5	49			
2	39	13	7,669	0,0547	6	49	22	17,609	0,5233
3	39	53	7,421	0,1221	7	49	06	17,983	0,0641
4	39				1	50	22	17,282	0,4191
5	39	21	8,000	0,3276	2	50	12	18,175	0,5752
6	39	18	7,806	0,1115	3	50	44	17,636	0,7768
1	40	19	69,311	2,2450	4	50	14	18,343	0,7270
2	40	13	73,792	13,3634	5	50			
3	40	42	71,288	14,9288	6	50	17	17,782	0,5948
4	40	15	71,933	15,6409	7	50	23	18,017	1,1546
5	40	22	72,118	21,3682					
6	40	08	70,838	16,1244					
7	40	01	73,000						

Table 7.

Group no.	Measurement no.	Total number of individuals	Mean value	Variance
1	51	22	5,400	0,1155
2	51	13	5,815	0,0697
3	51	47	5,540	0,1460
4	51	13	5,585	0,0868
5	51			
6	51	09	5,667	0,2426
7	51			
1	54	21	7,743	0,1862
2	54	12	7,958	0,1584
3	54	45	7,913	0,3540
4	54	15	7,947	0,3398
5	54			
6	54	28	8,139	0,2183
7	54	20	7,625	0,1999
1	55	19	4,321	0,0400
2	55	11	4,491	0,0877
3	55	42	4,421	0,1298
4	55	15	4,260	0,1824
5	55			
6	55	28	4,586	0,1742
7	55	10	4,180	0,0296
1	56	22	12,982	0,2936
2	56	13	13,615	0,3312
3	56	48	13,263	0,4865
4	56	15	13,693	0,5559
5	56	21	13,190	0,5605
6	56	65	13,449	0,4696
7	56	25	13,396	0,4772
8	56	37	13,551	0,4952
1	57	22	6,423	0,1000
2	57	13	6,862	0,0469
3	57	48	6,625	0,1640
4	57	15	6,700	0,1693
5	57	21	6,452	0,2440
6	57	30	6,807	0,1744
7	57	21	6,643	0,1291
8	57	39	6,654	0,2339

JAN 26 '79
APR '84
3740
a

PAM 599.742.4:591.134

Date Due

University of Alberta Library
0 1620 0329 9607